
Marine Physical Laboratory

Source Signature Estimation and Noise Directionality in Shallow Water

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Abstract

Two experiments were carried out in August-September 1993 in a shallow water test bed region off the coast of southern California. SWellEx-1 (Shallow Water evaluation cell Experiment #1), was carried out in August 1993 west of Point Loma in approximately 200 m water. SWellEx-2 (also known as the Site Specific Experiment or SSE) was carried out in September 1993 adjacent to San Clemente Island in both 450 m and 1200 m water. During both of these experiments, along-slope and cross-slope controlled source tow events were carried out for the purpose of validating predictions made by full-wave propagation models as well as to carry out an initial look at matched-field processing in shallow water. In addition, several days of ambient noise data were collected during these experiments providing an opportunity to look at the time-evolving characteristics of ambient noise horizontal and vertical directionality in shallow water. As expected, shipping noise varied substantially due to fluctuations in traffic patterns. The contribution of biologics to the noise background (at night) was surprisingly large.

Research Objective

The objective of this project was to carry out an initial analysis of the data from the SWellEx-1 and SWellEx-2 experiments which were conducted in August-September 1993 in a shallow water test bed region off the coast of southern California.

Research Summary

Two experiments were carried out in August-September 1993 off the coast of southern California in a shallow water test bed region bounded by Point Loma (San Diego), San Clemente Island, and Camp Pendleton.

SWellEx-1 (Shallow Water evaluation cell Experiment #1), was carried out in August 1993 west of Point Loma in approximately 200 m water. During SWellEx-1, two hydrophone arrays were deployed. The first was a MPL 48-element vertical array deployed from the R/P FLIP. The second was a McDonnell-Douglas 8x8-element horizontal planar array deployed on the seafloor and cabled back to FLIP for data recording. SWellEx-2 (also known as the Site Specific Experiment or SSE) was carried out in September 1993 adjacent to San Clemente Island in both 450 m and 1200 m water. During SWellEx-2, two hydrophone arrays also were deployed. The first was the NRaD SSE (Site Specific Experiment) engineering test array which was deployed in 1200 m water and cabled back to San Clemente. The second was a MPL 64-element vertical array deployed in 450 m water from the R/P FLIP.

The focus of this effort was an initial analysis of the data from these two experiments. The work was carried out in collaboration with NRaD/NCCOSC (Code 541). Primarily, NRaD's emphasis was on propagation modeling and matched-field processing while MPL's emphasis was on data distribution, quick-look analysis of the array data, and characterization of the time-evolving spatial structure of the ambient noise field.

Immediately after the two experiments, the integrity of the data collected by the MPL vertical arrays was documented in a quick-look analysis of the first 5 min of every data tape (each 8 mm tape recorded approximately 3 hr 20 min of data). There were 68 tapes recorded during SWellEx-1 and 69 tapes recorded during SWellEx-2. These results are contained in [1,6]. In addition, a quick-look analysis was carried out of

the integrity of the data collected by the NRaD SSE array deployed during SWellEx-2 [9].

MPL had responsibility for distributing the data collected by the MPL vertical arrays during SWellEx-1 and SWellEx-2. This involved carrying out low-level quality checks on the raw data (time stamp integrity, etc.), transcribing into an archival data format (SIO data files), and copying the tapes for other experiment participants. Documentation from the low-level quality checks is contained in [2,7]. In addition, transcription of the USTS data was carried out and documented in [4].

As an aid to the analysis of SWellEx-1 and SWellEx-2 data, MPL generated half-hour, time-evolving spectral analysis plots (grams) of the entire data set collected by the MPL vertical arrays and the USTS array [3,8,5]. These have proven quite valuable in understanding various aspects of the data - specifically, when nearby shipping is present.

The emphasis in our ambient noise characterization effort was focused on SWellEx-1 data due to the experiment location (just outside the moderately busy port of San Diego) and availability of both a vertical array and a horizontal planar array. These two arrays provided a unique opportunity to observe simultaneously the time-evolving vertical and horizontal directionality of the shallow water ambient noise field. Several selected data segments were analyzed over a variety of time scales (e.g. 6 hours, 1.5 hours, and 0.25 hours). Dominant shipping sources were identified geographically and the observed vertical and horizontal directionality related to source-array propagation characteristics. A surprisingly large contribution to the ambient noise field at night was due to biologics (sounds made by fish of the croaker family). The results from this analysis are contained in [10-11].

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